**Lecture: Malting**

**Date: February 11th**

**Basic Steps of Malting:**

1. Barley Harvested
2. Steeped in water, allowed to absorb 50% of its weight in water
   1. 38-46 hours, water changes every ~8-12 hours to prevent staling
   2. This stimulates germination
3. Barley moved to germination room
   1. Temperature and humidity controlled
   2. Grain is turned periodically
   3. Modification occurs
   4. “*Green Malt*”
4. Green Malt moved to Kiln
   1. Grain dried slowly to remove moisture, turned
   2. 122-158 F
   3. Achieve 4% moisture content (down from 50%)
   4. “*Base* or *Lager Malt*”

**Biology of Malting: Modification**

**The Interplay between the starches the grain unlocks and uses to grow and the sugars left over for brewing**

**Endosperm:** Contains the large and small starch granules we are after

Beta-Glucans: Cellulose

Pentosans: Linked Pentose sugars

Various Proteins, Beta-Glucans, and Pentosans: Hold together the starch granules

**Aleuron**: All seeds contain this layer. In barley it is multilayered. This layer contains the enzymes that break apart Beta-Glucans, Pentosan, and protein matrix that hold the starch granules. The Enzymes are amylases, glucanases, proteases.

**Modification**: As the seed germinates the seed grows. The length of the tip, the acrospire, grows. When the acrospire reaches 75-100% the length of the seed a grain is fully modified. Once fully modified the seeds are kilned to stop germination, rootlets are tumbled off, and seed is dried. This heat also denatures several enzymes, the ones that are left behind are the ones that are most important – they break down starches into fermentable sugars.

**Malt Analysis:**

Determined by the maximum amount of soluble material that can be extracted from 50 grams of finely ground malt. The target number is 80%.

**Protein Extraction:**

An approximation based on the total amount of nitrogen in a malt sample.

Every 1% of Nitrogen in the total weight represents 6.25% protein

Ranges for % of total weight being protein:

2 Row: 11-13% American Grain, 9.5-12% European Grain

6 Row: 12-13.5% for all

\*Above 13.5% is not used for beer = animal feed

**S/T Ratio - Kolbach Index:**

Of the total protein, only about 38-45% is made soluble

-Includes enzymes, foam retaining proteins, and assorted amino acids

Ratio of soluble protein to total protein is described as nitrogen

Soluble Nitrogen/Total Nitrogen = Extent of unlocked endosperm

Under Modified: 36-40% ratio. Not enough starches will be released. Low extraction from starch matrix.

Well Modified: 40-44% ratio. Optimal batch.

Over Modified: 44-48%. Too many sugars are consumed. Loss of body, beer haze, excessive darkening.

**Diastatic Power**: Amount of conversion that can occur during mashing due to the enzymes unlocked during modification and left over after malting process.

Measured in degrees Litner °L not to be confused with Lovibond. Degrees Litner are referred to as Diastic Power (DP). A malt with a DP greater than 40 contains enough enzymes to saccharify itself.

**Litner**: A malt has a diastatic power of 100 °L if 0.1cc of a clear 5% infusion of the malt, acting on 100cc of a 2% starch solution at 20°C for one hour, produces sufficient reducing sugars to reduce completely 5cc of Fehling's solution.

**Barley**: 2-Row vs 6-Row

2 Row: Larger,, lower protein, lower diastatic power

6 Row: Smaller, higher protein (more body), higher diastatic power

**Types of Malts:**

4 Malt Types: Base, Kilned, Roasted, Kilned & Roasted

Those that require mashing: Base, Kilned Malts, and some Roasted malts

Those that do not: Roasted (Carmal) and Kilned & Roasted

Those not obtained from malted barley: Refined Sugars, Corn, Rice, Unmalted Rye, Wheat, Unmalted Barley

Malt Flavors are developed by:

Varying moisture level

Kilning and Roasting Times

Kilning and Roasting Temperatures

**Chemistry of Malting:**

Caramalization: Dependent on high temperature (230-320 F) and low moisture content (>3%)

-Sugar thermally decomposes via pyrolysis (Endothermic) (decomposes in the absence of O2­)

Flavors: caramel, toffee, burnt sugar, honey

Color: Light to dark brown

|  |  |
| --- | --- |
| **Sugar** | **Temperature** |
| Fructose  Galactose  Glucose  Sucrose  Maltose | 110 C / 230 F  160 C / 320 F  160 C / 320 F  160 C / 320 F  180 C / 320 F |

Maillard Reactions**:** Sugar and Amino Acid reactions dependent on moisture content 3-10%

Creates:

- volatile, low molecular weight flavors

-higher molecular weight reductones (bind to oxygen and improve flavor) = antioxidants

-cont. melanoidins (browning colors)

Flavors: toasty, biscuit, burnt, chocolate, buttery

Color: brown - black

\*\*See hand out

**Malts:**

**Light (base) Malts:** Provides the base for beers. These malts have a high enough DP to break down their starch reserves into fermenting material.

|  |  |  |
| --- | --- | --- |
| **Base Malts** |  |  |
| **Type:** | **Description** |  |
| Lager/Pilsner | Kiln Temp: 90 F (24 hours) | Pre-heat treat |
|  | Kiln Temp: 120 - 140 F (12-20 hours) | Dried |
|  | Kiln Temp: 175-185 F (4-48 hours) | Cure |
| Pale Ale | Slightly higher temps than lager |  |
|  |  |  |
|  |  |  |
| Wheat Malt | Kiln Temp: 100-125 F (24 hours) |  |
|  | 5-70 % of total grain bill |  |
|  | No outer husk = less tannins |  |

Lager/Pilsner malt is the base malt of the world.

Caramalization is the major flavoring and coloring agent for these malts agent